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ABSTRACT

The course content, specific objectives, and evaluation for a science teaching methods course required for students planning to be secondary school science teachers in the biological, physical, or earth sciences are described. (CS)

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Syllabus

Methods and Materials in Teaching Secondary School Science

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Prepared by:

Dr. Thomas J. Gallia
(Revised 1981)

SE 035 422

INTRODUCTION

Methods and Materials of Teaching Secondary School Science is a course designed for the student interested in a career as a secondary, biological, physical or earth science teacher. The course is implemented through two fundamental thrusts, one campus centered, the other taking place in a public school laboratory.

Campus sessions attempt to uncover the philosophical and psychological premises underlying a variety of approaches to teaching science. Teaching simulation, role playing, gaming, mock-laboratories, micro-teaching and field experience are among the strategies employed in providing the preservice science teacher the opportunity to gain familiarization with the more practical aspects of science teaching. The critical role of the science educator as the individual at the interface of science and society is stressed throughout the course.

The laboratory thrust of the course involves a minimum of four hours each week working in science classrooms of a local secondary school. College students assume the role of teaching assistants, helping experienced classroom teachers with science laboratory experiences, field trips, demonstrations, tutoring, marking papers, developing audio-visual aids, constructing bulletin boards, micro-teaching, individualized instruction for the handicapped, and a variety of other mutually beneficial responsibilities. Experiences gained in the public school laboratory are related to the discussion and activity sessions held on campus. Opportunities are sought for the college student in realistic mainstreamed classroom situations. The laboratory becomes the proving ground for newly acquired instructional techniques, psychological and educational theory.

CREDIT HOURS

Methods and Materials in Teaching Secondary School Science . . . . . 4 S.H.

TIME AND SEQUENCE

The science teaching methods course is a required course and prerequisite for the Professional Semester of Science Teaching (Senior year Practicum/Student Teaching). Most students elect it in the junior year.

COURSE CONTENT

The structure of the science teaching methods course is one permitting flexibility. Several themes, however, prevail each time the course is conducted.

A. The teacher as a facilitator in the learning process.
B. Inquiry and the Science Curriculum Movement.
C. The nature of science and science teaching.
D. Basic instructional techniques.
E. Teacher-student interpersonal relationships.
F. Cognitive and affective development in children.
G. Science, society and human values.
H. Equal access to educational opportunity.

Some of the specific discussion, lecture, readings and activity topics include:

(1) The Nature of the Conceptual Schemes Approach to teaching Science.

(2) Discipline in the classroom, Teacher-Student Values Collisions. Identifying and handling students with behavioral disorders.

(3) The Taxonomy of Educational Objectives.

(4) Planning for effective teaching, behavioral objectives, lesson plans, units, contracts, individualized instruction and learning centers.

(5) Designing or reconstructing the physical environment of the science classroom. Making the classroom physically accessible to <u>all</u> students.

(6) Inquiry and guided learning, the theories of Bruner and Gagne as they relate to science teaching.

(7) Piaget's cognitive developmental model and its implication to secondary science teaching.

(8) Science Fiction and Science Teaching.

(9) Synetics - teaching by analogy.

(10) Affective dimensions in education, Values Education, Kohlberg's moral development construct.

(11) Developing a perspective for the History of Science.

(12) The Structure of Scientific Revolutions (kuhn).

(13) Unified Science.

(14) Science and the Two Culture Argument (Snow).

(15) The Science curriculum movement: An introduction to some of the more popular programs, (BSCS, PSSC, IPS, TSM, ESCP, IIS, ISCS, MACOS, ES, PPC, OBIS, HSP, ISIS, ETC.)

(16) Controversial issues in the classroom, i.e., evolution, sex education, technology vs. environment, etc.

(17) How to:

a) Apply for a teaching position.
b) Interview for a science teaching position.
c) Select the appropriate school system for employment.
d) Continue to develop as a science educator after graduation.

(18) Designing and implementing motivational teaching strategies.

(19) Handicapped children in the science classroom.

(20) A linguistic approach to learning science vocabulary.

(21) Teaching science to non-English speaking students.

(22) Cascade system of mainstreaming of handicapped students.

(23) Science projects, term papers, science fairs, - what value in secondary teaching?

(24) Interpersonal relations in the classroom.

(25) Evaluating learner progress - tests, quizzes, exams, grading philosophy, etc.

(26) Science Teaching and the Law.

(27) Safety in the laboratory.

(28) Audio-visual aids in the classroom.

(29) Science and Art, science as art.

(30) Professional organizations, journals and conventions for science educators.

(31) Teaching for career development in science.

(32) Futuristics.

(33) Individualized Instruction - the ISCS-ISIS Model, (IPI) Individually Prescribed Instruction and (IEP) Individualized Education Plans for the handicapped child.

(34) Reading and science teaching, selecting and establishing the role of the science textbook.

(35) Self-evaluation.

(36) What does research say about science teaching?

(37) Ethics and teaching.

(38) Line and staff organization of schools.

(39) Graduate Studies in Science Education.

(40) Deciding what should be taught?

(41) Science and the Condition of Man (Bronowski, Ellul, Ferkis, Tielhard, Monad, Snow, etc.)

(42) Science teaching facilities. Designing a barrier free laboratory.

(43) Integrating science with mathematics, social studies, English, Art, etc.

(44) BSCS for the educable and mentally handicapped Me Now & Me and My Environment Programs.

(45) Optical media for teaching science to the visually and hearing impaired child.

(46) Science programs for the gifted student.

(47) Advantages and disadvantages of lecture, discussion, laboratory, etc.

(48) Discrepant Event Teaching.

(49) The Spirit of Science as a neatly woven schema of content, process and values.

(50) Developing a personal educational philosophy.

(51) Rationales for lesson planning.

(52) Parent-teacher relationships.

(53) Homework, its value and misuse.

(54) How to plan, organize and run a successful field trip.

(55) How to make the home a learning environment.

(56) Failure - What it means to the teacher, student and parent.

(57) How to effectively:

a) Ask good questions
b) Give an exciting demonstration
c) Conduct a laboratory experience
d) Facilitate and help manage a good discussion
e) Limit time spent lecturing
f) Deal with a heterogeneous class that includes "mainstreamed" children

(58) Women and minorities in science teaching.

(59) Science and para-science.

(60) Science and religion. Teaching evolution or creationism.

(61) Incidental or unanticipated learning.

(62) Maladaptive Teaching Habits.

(63) The implications of Public Law 94-142 (1975) for teaching science in the secondary school.

(64) How to detect behavioral signs that are indicative of potential handicap.

(65) Science careers for the handicapped.

(66) The student will be able to summarize the "cascade" system.

SPECIFIC OBJECTIVES

Students are provided with a list of sample educational objectives written in an abbreviated competency-type format. The list is a partial one and a working draft modified throughout the course by student, instructor and cooperating public school personnel.

A. Sample objectives concerning the nature of science.

The student will be able to:

1. Provide a definition of science which reflects evidence of content, process and value dimensions.
2. Describe the meaning of scientific literacy.
3. Distinguish between facts, principles, and concepts in science.
4. Discuss with evidence of familiarity, the ideas and positions of contemporary prominent philosophers of science and science critics concerning the role of science in society (i.e., Monad, Tielhard, Roszack, Skinner, Snow, Kuhn, Bronowski, Stent, Eiseley, Sarton, Conant.)
5. Provide a clear statement of personal philosophy of science education.

B. Sample objectives concerning instructional foundations.

The student will be able to:

1. Provide a working definition of inquiry.
2. Evaluate six different teaching strategies and execute each in a classroom environment.
3. Respond to a number of simulated classroom dilemmas involving interpersonal relationships.
4. Write clearly stated instructional objectives.
5. Identify and apply a technique for textbook evaluation.
6. Distinguish between "product" and "process" teaching.
7. Prepare an inquiry instructional sequence.
8. Describe acceptable homework strategies.
9. Identify the essential components and the science teachers responsibility in the cooperative design of IEP's.

10. Describe special programs, strategies and problems in teaching the gifted and talented student.

11. Organize and supervise field studies.

12. Establish a set of guidelines for safety in the laboratory.

13. Construct sample questions based on Bloom's Taxonomy.

14. Prepare a unit (or some of long-term plan) that integrates competency in subject matter with understanding of how children learn creative instructional strategies.

15. Give a list of affective implications of science teaching.

16. Design a moral dilemma and crude evaluation criteria involving some scientific or technological social confrontation.

17. Explain the theories and their implications for science education of the following:

    a. Jerome Bruner
    b. Robert Gagne
    c. Jean Piaget
    d. Lawrence Kohlberg
    e. John Dewey

18. Utilize a standard technique of assessing the readability of a science textbook.

19. Prepare evaluation activities which reflect stated objectives.

20. Describe acceptable practices concerning testing and grading.

21. Analyze materials and determine which are stated in conceptual terms.

22. Analyze and evaluate discussion and questioning techniques.

23. Work cooperatively and productively in team planning.

24. Describe the legal responsibilities of science teacher.

25. Join a professional organization for science teachers.

26. Identify students with hearing or visual impairments.

27. Design a barrier free science laboratory.

28. Develop or redesign science curriculum materials for students who have visual or hearing impairments, learning disabilities, orthopedic handicaps, etc.

29. Integrate science career opportunities into curriculum planning.

C. Sample objectives concerning science curricula.

The student will be able to:

1. Identify and provide a basic overview of the following curriculum projects:

   a) BSCS
   b) ISCS
   c) ISIS
   d) MAPS
   e) HPP
   f) PSSC
   g) CHEMS
   h) SPIES
   i) IIS
   j) ESCP
   k) OBIS
   l) IPS
   m) ME NOW (BSCS for Learning Disabled)

2. Comment on the utility of the Conceptual Schemes and Unified approaches to teaching science.

3. Describe the events that led to the science curriculum movement of the 1960's.

D. Sample objectives involving educational media.

The student will be able to:

1. Design and construct a bulletin board to meet group specified criteria.

2. Operate an 8mm film loop projector.

3. Operate a reel-to-reel sound tape recorder.

4. Operate a cassette recorder.

5. Prepare overhead transparencies and use the overhead projector.

6. Prepare mimeograph stencils.

7. Write legibly on the chalkboard and demonstrate good chalkboard technique.

8. Prepare spirit masters and use duplicating machine.

9. Identify sources of free and inexpensive materials.

10. List several ways in which commercial and public television can act as a teaching tool.

11. Identify ways in which 3 dimensional "tactile" models may be used in teaching science to the visually impaired.

12. Design diagrams, charts, pictures, etc. to supplement instruction for the auditory handicapped.

EVALUATION

Evaluation will be both continuous and summative and will include the following:

A. Course evaluation by instructor, student and cooperating school professional.

B. Student evaluation by instructor.

C. Instructor evaluation by student.

D. Student evaluation by cooperating school professionals and secondary students.

E. Instructor self-evaluation.

F. Student self-evaluation.

Throughout the course students progress will be monitored as related to the objectives of the course. Continuous evaluation will be constructively designed to help the student develop and improve competencies. The quality of discussion, work in the public school laboratory, demonstrations, mini lessons, unit plans, assignment completion, and exams will all be utilized in the evaluation process. The students themselves will be integrally involved in designing criteria for their own evaluation and self-evaluation.

Course and instructor evaluation will be conducted with the aid of standardized instruments. In this way, data will be suitable for comparisons from semester to semester and kept for potential departmental evaluations.

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